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The Epidemic of COVID-19-Related Erectile Dysfunction: A Scoping Review and Health Care Perspective

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Abstract

Introduction: COVID-19 infection is expected to be associated with an increased likelihood of erectile dysfunction (ED). Considering the high transmissibility of COVID-19, ED may be a concerning consequence for a large segment of the population.

Aims: To (1) summarize existing published evidence for the impact of COVID-19 on the prevalence, severity, treatment, and management of ED; and (2) identify health-related trends in the emerging literature and identify gaps in the existing research literature and make recommendations for future research needs in the area.

Methods: A scoping literature search was conducted on April 27, 2021. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Extension for Scoping Reviews (PRISMA-ScR) checklist was followed. The literature search was performed in PubMed using the terms: COVID-19, erectile, sexual, and dysfunction. A total of 693 publications were screened for relevance. Studies were appraised for their level of evidence based on study design and the rigor of methodology.

Results: The evidence that COVID-19 infection causes or impacts ED is compelling. Four topics emerged regarding the nature of the association between COVID-19 and ED: (1) the biological impact of COVID-19 infection on ED; (2) the mental health impact of COVID-19 on ED; (3) the impact of COVID-19 on the management of ED and access to ED treatment; and (4) health disparities and the impact of COVID-19 on ED. Long-term and well-designed studies are needed to clarify the extent of the impact of COVID-19 on ED. The pandemic exposed several vulnerabilities within worldwide healthcare and social systems.

Conclusion: COVID-19 has a uniquely harmful impact on men's health and erectile function through biological, mental health, and healthcare access mechanisms. As the pandemic wanes, strategies to identify

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long-term effects and additional health care support may be needed to adequately mitigate the impact of COVID-19 on men's health.

Abbreviations

ACE2, angiotensin-converting enzyme 2

BMI, body mass index

ED, erectile dysfunction

FSFI, Female Sexual Function Index

IIEF, International Index of Erectile Function

IL, interleukin

IQR, interquartile range

IS, intercourse satisfaction

NHANES, National Health and Nutrition Examination Survey

OS, overall satisfaction

PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PRISMA-ScR, Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews

PTSD, post-traumatic stress disorder

SARS-CoV-2, severe acute respiratory syndrome coronavirus 2

SD, sexual desire

TNF, tumor necrosis factor

Introduction

The COVID-19 pandemic has had a devastating impact on the health and wellbeing of people across the world. The uniquely harmful impact of the virus on men's health is becoming more apparent and is more

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commonly being documented in the published medical literature.[1-3] Men have been shown to have an increased risk of both developing the severe form of COVID-19 and dying from it.[3, 4] Biological (sex) and socio-cultural (gender) factors, compounded by socio-economic factors and ethnicity, have had a marked impact on the aftermath of COVID-19.[2, 3] Testosterone has been identified as a bivalent risk factor for poor prognosis (high/normal in younger; lower in elderly) in COVID-19.[1] It has been postulated that testosterone may facilitate SARS-CoV-2 entry in human cells and men may develop a blunted immune response against SARS-CoV-2, being exposed to less viral clearance and more viral shedding and systemic spread of the disease.[1] Low levels of serum testosterone observed in men, on the other hand, may predispose them to greater background systemic inflammation, cardiovascular and metabolic diseases, and immune system dysfunction from COVID-19 infection, hence potentially enhancing the long-term consequences of the virus.[1] Even men who have never contracted COVID-19 have had their lives severely affected by the pandemic both physically and emotionally as it has caused widespread disruption to normal existence, men's social world, preventative health and healthcare access, and the economy.[2]

One of the repercussions of COVID-19 is its impact on men's sexual health. COVID-19 infection is expected to be associated with an increased likelihood of erectile dysfunction (ED). Considering the high transmissibility of COVID-19, ED could be a concerning consequence for a large segment of the population.[5] However, to our knowledge, the evidence for the association between COVID-19 and ED has not been collectively gathered, integrated, and appraised. The objectives of this study were to conduct a scoping literature review to: (1) summarize existing published evidence for the impact of COVID-19 on the prevalence, severity, treatment, and management of ED; and (2) identify health-related trends in the emerging literature and identify gaps in the existing research literature and make recommendations for future research needs in the area.

Materials and Methods

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The approach for the literature review was a scoping review given the heterogenous nature of the body of literature describing the relationship between COVID-19 and ED [6]. Scoping reviews are a relatively new approach to evidence synthesis.[7] They can synthesize research evidence and categorize or group existing literature in a given field in terms of its nature, features, and volume.[8] Researchers may conduct scoping reviews instead of traditional reviews when the purpose of the review is to identify knowledge gaps, scope a body of literature, clarify concepts, or to investigate research conduct.[7] Scoping reviews may also be helpful precursors to traditional systematic reviews and can be used to confirm the relevance of inclusion criteria and potential questions.[7] They deliberately cast a wider net to identify topics that are connected but not necessarily completely within the topic of interest in order to help better discern boundaries of relevant literature. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Extension for Scoping Reviews (PRISMA-ScR) Checklist[9] was followed and adhered to in conducting the scoping literature review.

The literature review used the PubMed search engine and was conducted on April 27, 2021 with the search terms “COVID-19”, “erectile”, “sexual”, and “dysfunction”. A total of 693 publications were obtained using the search strategy Studies were included if they provided information about the relationship between COVID-19 and ED or if they discussed patients’ experience of care during COVID-19. All studies underwent a title and abstract screening, and potentially relevant citations were checked in a full-text screening. Reference lists of selected articles were also reviewed for additional possible sources of information (**Figure 1**). Data extracted included the journal citation, publication year, country of origin, study design, and a summary of the pertinent findings. Studies were appraised for their level of evidence based on study design and the rigor of methodology used, as well as the ability to prevent and/or control for biases to analyze cause and effect.

Results

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A total of 60 studies were selected for inclusion in the scoping review. **Table 1** presents the characteristics of the included studies and a summary of their findings. Twenty-three studies (38.3%) were from the US, 10 were from Italy (16.7%), six were from China (10.0%), five were from Turkey (8.3%), four were from India (6.7%), two each were from Canada, Greece, and Brazil (3.3%), and one each were from Japan, Iran, the UK, the Netherlands, Egypt, Finland, and Portugal (1.7%) (note that one study was from the US and Iran). Twenty-five studies were narrative/literature reviews (41.7%), 12 were patient surveys (20.0%), 11 (18.3%) were expert commentaries/editorials, three were retrospective database evaluations (5.0%), two were urologist surveys (3.3.%), two were systematic reviews/meta-analyses (3.3%), and one each was a prospective cohort study, a retrospective chart review, a case series, a case report, and laboratory/pre-clinical research (1.7%).

Many of the studies identified in the literature review examined how COVID-19 may affect ED prevalence and severity either directly or indirectly through the extensive impact of the virus on men's genitourinary, cardiovascular, and nervous systems (n = 26; 43.3%). Another large grouping of studies addressed the mental and psychosocial aspects of COVID-19 and ED (n= 28; 46.7%). Twenty-two studies (36.7%) described how COVID-19 had affected patients' access to ED care and changes in ED management since the pandemic. Disparities in care and the effect of ED and COVID-19 on vulnerable populations was addressed in 18 studies (30.0%). The studies that contributed to each of these four groupings are also noted in **Table 1**.

Discussion

Four topics emerged regarding the association between COVID-19 and ED: (1) the biological impact of COVID-19 infection on ED; (2) the mental health impact of COVID-19 on ED; (3) the impact of COVID-19 on the management of ED and access to ED treatment; and (4) health disparities and the impact of COVID-19 on ED. **Table 1** outlines the topics covered by each of the included studies and **Figure 2** illustrates the

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interactions of the four emergent topics. The following summaries highlight the most significant findings that were revealed for each of the four topics.

Topic 1: Biological Impact of COVID-19 Infection on ED

Evidence that COVID-19 may biologically impact ED both in regard to the prevalence of ED (i.e., the number of men with ED) and the severity of ED in men with existing ED is beginning to emerge. A retrospective chart review of 12 outpatient urology clinics across Turkey investigated whether there have been variations in the presentations of male patients with sexual and reproductive health problems during the COVID-19 pandemic.[10] Andrological problems (i.e., ED, premature ejaculation, Peyronie's disease, and priapism, varicocele, infertility, primary/secondary hypogonadism, anejaculation, spermatocele, and undescended testicles) were detected in 721 of 4,955 male patients included in the study. Study findings showed that there was a significant increase in overall andrological diagnosis in these patients during the pandemic period compared with the pre-pandemic period (n = 293 [17%] vs n = 428 [13.2%], $p < 0.001$, respectively) (**Figure 3**). The number of patients diagnosed with ED during the pandemic was significantly higher during COVID-19 compared to the pre-COVID-19 pandemic period (n = 150 [8.7%] vs n = 214 [6.6%], $p = 0.008$) (**Figure 3**).[10] The authors hypothesized that possible reasons for more frequent presentation to the outpatient urology clinics with ED may include relationship strain due to the "Stay Home" policies, job losses and economic problems, and increased anxiety and depression. Limitations of this study include its retrospective design, lack of randomization, differences in patient baseline characteristics between the comparison groups, and potential confounding from unknown and/or unmeasured variables.

An Italian online survey study by Sansone and colleagues (2021) compared the prevalence of ED among men with (n = 75) and without (n = 25) COVID-19 using 3:1 propensity score matching.[11] Study findings showed that the prevalence of ED as measured with the Sexual Health Inventory for Men was significantly higher in the COVID-19 group (28.0% vs. 9.3%; $p = 0.027$). Logistic regression models confirmed

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a significant effect of COVID-19 on the development of ED, independently of other variables affecting erectile function, such as psychological status, age, and body mass index (BMI). Age, BMI, and psychological health scores failed to reach statistical significance; however, history of COVID-19 was highly significant, resulting in a 5.66 odds ratio (95% confidence interval: 1.50–24.01) of having ED.

The physiology relevant for penile erection may be affected by COVID-19 through vasculogenic, neurogenic, and endocrine mechanisms. A literature review of the possible mechanisms involved in the development of ED in COVID-19 survivors by Sansone and colleagues (2021) found that endothelial dysfunction, subclinical hypogonadism, and impaired pulmonary hemodynamics all contribute to the potential onset of ED.[65]

Vascular integrity is necessary for erectile function. Accumulating evidence suggests that SARS-COV-2 damages the vascular endothelium,[12] the layer of specialized cells lining the inner surfaces of blood vessels and spaces like the surface of the sinusoids of tissues like the corpus cavernosum of the penis.[13] The endothelium expresses the protein angiotensin-converting enzyme 2 (ACE2), through which SARS-COV-2 can access host cells.[14, 15] The vascular endothelium regulates the vascular tone, coagulation, metabolism, and permeability of the vessels.[13] Endothelial dysfunction results in abnormal regulation of blood pressure, response to inflammation, impairment of the sensitive balance between the vasoconstricting and vasodilating agents and stimuli, and coagulation disorders.[13, 16] Vascular damage associated with COVID-19 is likely to affect the fragile vascular bed of the penis, potentially resulting in impaired erectile function.[5] The recognized relationship between vascular health and ED[22] suggests an important knowledge gap that could be addressed with translational research to elucidate the penile vascular effects of COVID-19 and their relationship to ED.

ED that manifests during COVID-19 may be a signal for underlying cardiovascular disease and may provide opportunities for earlier assessment of vascular dysfunction. ED, as a surrogate marker of

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cardiovascular and/or pulmonary health, could become extremely valuable as a quick and inexpensive first-line assessment of the pulmonary and cardiovascular complications for COVID-19 survivors.[65] The study by Sansone and colleagues (2021) also measured the likelihood of having a self-reported history of COVID-19 following a diagnosis of ED. Logistic regression models adjusted for age and BMI showed a significant association between ED and COVID-19, with a 5.27 odds ratio [95% CI: 1.49–20.09]. Evidence coming from diagnostic procedures, such as penile color-doppler ultrasound and hypothalamic-pituitary–testicular axis evaluation, may aid in assessing the extent to which COVID-19 has been able to impair erectile, and finally vascular, function.[65]

COVID-19 may also affect ED prevalence and severity through the indirect impact of the virus on men's cardiovascular system and through the indirect effects of treatments for COVID-19.[65] For example, in some cases, COVID-19 may cause acute cardiac injury, leading to a decrease in blood supply to genitalia.[23] Also, COVID-19 patients admitted to the ICU who are given thiazide-type diuretics, aldosterone receptor blockers, β-adrenergic receptor blockers, or ACE inhibitors to control blood pressure are believed to be at risk for ED.[23]

It has been demonstrated that patients with COVID-19 commonly have neurologic manifestations.[24] Disorders of the central and peripheral nervous system are present in most COVID-19 patients, while stroke, ataxia, seizures, and depressed level of consciousness are more common in severely affected patients.[25] The neurological effects observed in some cases of COVID-19 may also have negative impacts on ED.[23] Neurogenic ED consists of a large cohort of ED, accounting for about 10% to 19% of all cases.[26] Neurological effects can occur via direct infection injury (blood circulatory pathway and neuronal pathway), hypoxia injury, ACE2, and immune injury[27] The tremendous diversity in the etiological factors associated with neurogenic contributors to ED[26] combined with the multidimensional effects of COVID-19 demonstrate the importance of further exploring the impact of COVID-19 infections on the nervous system.[27]

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Finally, ED may be affected by COVID-19 through endocrine mechanisms. COVID-19 features a state of hyperinflammation promoted by the same inflammatory cytokines found to be associated with clinical progression of sexual dysfunction (tumor necrosis factor [TNF]-α, interleukin [IL]-6 and IL-1β).[5] Although COVID-19 has been shown to cause systemic inflammation predisposing the involvement of multiple organs, the extent of its effect on the urogenital system has not yet been adequately researched.[17] It has been theorized that that testicular damage may result following COVID-19 infection.[18, 19, 28] The ACE2 gene is a receptor of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) for COVID-19. High levels of ACE2 expression in testes indicate that SARS-CoV-2 might affect the testes, potentially affecting male sexual function.[14, 20] The effects on testicular tissue may harm testosterone production which may, in turn, have an association with ED insofar as its endocrine pathophysiologic risk.[65] The more likely effect of testosterone deficiency resulting from COVID-19 infection is decreased sexual libido, and lesser risk on decreasing erection ability.[65]

Endothelial damage by SARS-COV-2 tied to endothelial expression of ACE2 combined with testosterone's role in modulating endothelial function[66] and associated inflammatory effects could be a factor in the differential burden of COVID-19 observed in some men.[5] Men at greatest risk for having serious complications secondary to COVID-19 are those traditionally at risk for ED: older adult, diabetic, men with cardiovascular disease, overweight/obesity, and with multiple comorbidities.[29] Furthermore, weight gain as a result of the pandemic could have compounding long range adverse effects on the risks for overweight and obesity, diabetes, hypertension, and cardiovascular disease, all of which are associated with ED.[31]

Topic 2: The Mental Health Impact of COVID-19 on ED

It is important to consider the role of added stress, anxiety, and physical health implications for men with ED amid the COVID-19 pandemic.[29] Increased rates of post-traumatic stress disorder (PTSD), depression, and anxiety are expected in the general population, and even more in COVID-19 survivors,

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following the pandemic.[65] Anxiety and depression are commonly seen in men with ED.[32] Psychological and mental health issues may lead to ED or worsening ED. ED has been shown to be 1.3–2.3 times more common in individuals with anxiety and depression.[67] Although the psychological effects such as depression, anxiety, posttraumatic stress, and sleep disturbances are being studied for COVID-19, literature evaluating the relationship between these psychological and mental consequences and ED is rather scarce.[33]

Some evidence has shown that sexual behavior was altered during the pandemic, including a reduction in sexual desire and number of sexual partners during the lockdown.[34, 35] The COVID-19 outbreak has dramatically affected men's quality of life by changing inter-personal relationships, community life, and sexual health.[36] An Internet-based survey of 1,356 participants in Turkey in June 2020 evaluated sexual function in terms of sexual intercourse frequency and sexual desire during the COVID-19 pandemic using the International Index of Erectile Function (IIEF) and Female Sexual Function Index (FSFI) forms.[37] Study findings showed a decline in sexual function during the pandemic period (40.8% had decline in sexual intercourse frequency, 14.0% had decline in frequency of masturbation, and 31.5% had a decline in sexual desire), particularly among individuals living in metropolitan areas.[37]

An online questionnaire administered to Chinese men (n = 612) during the pandemic (April-May 2020) found that 8.4% and 8.5% subjects reported deteriorated erectile function or ejaculation control ability by self-evaluation, whereas 31.9% and 17.9% subjects showed decreased IIEF-5 scores or increased premature ejaculation diagnostic tool (PEDT) scores.[38] Subjects with deteriorated erectile function by self-evaluation and decreased IIEF-5 scores displayed higher General Anxiety Disorder-7 ($p < 0.001$ and $p = 0.001$) and higher Patient Health Questionnaire-9 score ($p < 0.001$ and $p = 0.002$) and decreased frequency of sexual life ($p < 0.001$ and $p < 0.001$) and physical exercise ($p = 0.009$ and 0.007).[38] Subjects with decreased frequency of sexual life had reduced income ($p < 0.001$), increased anxiety ($p < 0.001$) and depression ($p < 0.001$).[38]

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A study evaluating sexual activity and depression in a sample of hospital workers and their acquaintances (n = 544) during the COVID-19 lockdown in Italy analyzed responses to the IIEF-15, FSFI, and Beck Depression Inventory.[39] Levels of sexual satisfaction were measured with the IIEF-15 overall satisfaction (OS) and intercourse satisfaction (IS) domains. Low satisfaction levels were defined using an arbitrary cut-off score ≤12.5 in the sum of IIEF-IS and IIEF-OS domains. The sexual desire (SD) domain from the IIEF was also recorded and low sexual desire was defined using an arbitrary cut-off score of ≤5. The median (interquartile range [IQR]) IIEF-Erectile Function score was 10 (3, 11) and the IIEF-Orgasmic Function score was 3 (3, 5). The IIEF-Intercourse Satisfaction score was 5 (0, 7), IIEF-Overall Satisfaction score was 5 (4, 9), and the IIEF-Sexual Desire score was 4 (3, 5).[39] To our knowledge, there are no studies clearly defining a cut-off value for abnormal satisfaction domains for the IIEF-15. However, the IIEF validation study by Rosen et al. (1997) tested it in a series of 111 men with sexual dysfunction and 109 age-matched, normal volunteer controls.[68] The authors found that the mean OS scores were 8.6 for controls and 4.4 for patients, and the mean IS scores were 10.6 for controls and 5.5 for patients.[68] On average, controls scored 7.0 in the sexual desire domain and patients scored 6.3.[68]

The frequency of ED among male healthcare professionals (n = 159) during COVID-19 was also evaluated using the Impact of Event Scale-Revised (IES-R) and the IIEF-5 and compared to a control group of 200 people.[40] Both stress disorder and ED were seen at higher rates in healthcare professionals ($p < 0.001$).[40] The median IIEF-5 scores of male nurses, married subjects, and those working with confirmed COVID-19 patients, were found to be worse (15 [5–24] for physicians vs. 10 (5–23) for nurses, $p < 0.001$; 16 [5–24] for single vs. 12 [5–24] for married, $p = 0.014$; 15 [6–24] for suspected patient area vs. 11 [5–24] for diagnosed patient area, $p = 0.011$).[40]

A Turkish study evaluating the effect of COVID-19 pandemic on couples' sexuality (n = 245) utilizing the IIEF-15 found that male sexual function scores (IIEF erectile function domain) during the pandemic (May 2020) were statistically significantly lower compared to the pre-pandemic period (pre-pandemic 26.59 ±

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4.51 vs. during pandemic 24.55 ± 5.79 ; p = 0.001).[41]

Parallels can be drawn between the psychological consequences of COVID-19 and those coming from similar disasters, such as the 9/11 attacks or earthquakes, and similar short- and long-term treatment strategies are, therefore, needed to provide adequate care.[65] Tailored psychological interventions may be helpful in supporting patients who develop ED either from the illness itself or as a consequence of the containment measures.[65]

Topic 3: Impact of COVID-19 on the Management of ED and on Access to ED Treatment

Disruptions in elective and non-emergency medical care access and delivery were observed during COVID-19, particularly during periods of considerable community transmission of SARS-CoV-2.[56, 57] Many elective surgeries for benign urological conditions such as ED were postponed during the COVID-19 outbreak.[48-50, 69] One example summarizing shifts in men's urological care was published by the Canadian Urological Association.[51] It noted the massive shift in only offering surgeries for emergencies and urgent oncology cases with management shifting to mostly virtual care for male sexual health conditions.[51] Although not explicitly documented in the published medical literature, it is likely that the evaluation and treatment of ED was also postponed or delayed, potentially prolonging and possibly exacerbating ED problems.

The COVID-19 pandemic and related mitigation measures such as school closures and stay-at-home orders substantially affected patient healthcare- and medication-seeking patterns.[52-54, 56, 57] Overall, an estimated 40.9% of US adults avoided medical care during the pandemic because of concerns about COVID-19.[56] Age, gender, sexual identity, education, and self-reported worry about general health were significantly associated with experiencing healthcare delays overall.[57]

The COVID-19 pandemic exposed vulnerabilities within worldwide healthcare and social systems, some of them including services concerning sexual health.[42] The need for improved healthcare access was a

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reality for countless citizens who had never experienced a crisis with such a dimension.[42] COVID-19 required healthcare and social systems, clinicians, and citizens to adjust to the digital era in a matter of days.[42] E-Health interventions; that is, the increased use of communication and information technologies for health (e.g., short message service [SMS], e-mail, video call, cell phone applications, etc.) have been brought to the center of discussion for improved access to healthcare in challenging situations.[42] The World Health Organization followed by key professional societies such as the American Psychological Association deemed e-Health a priority target for the improvement of public and universal health.[42]

The COVID-19 pandemic has accelerated the use of telemedicine and in many ways, sexual medicine healthcare is ideal for telemedicine. Sexual medicine healthcare providers are a highly specialized group of clinicians who are frequently based in metropolitan areas.[60] Patients travel great distances to see sexual medicine care providers and telemedicine may increase outreach to patients who cannot otherwise access specialized care.[60] The COVID-19 pandemic has offered healthcare professionals an opportunity to re-examine delivery of sexual health services to hard-to-reach and vulnerable populations.[61] Providers can increase access to male sexual dysfunction treatment by removing traditional barriers to healthcare that these individuals routinely encounter.[61] Rapid advances in telehealth have increased virtual (e.g., phone or video) healthcare services and allowed access to confidential and private virtual care.[61] Virtual visits can also triage patients for in-person visits required for services.[61]

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Topic 4: Health Disparities and the Impact of COVID-19 on ED

The COVID-19 pandemic has magnified health disparities through loss of work and health insurance, having an impact on employee healthcare coverage and overall access to healthcare. In addition, the COVID-19 outbreak has amplified health disparities by race and gender in the US, perhaps most significantly for African American and Latino men.[62] The strain that the outbreak imposed on already resource-constrained health systems undoubtedly disproportionately impacted the health of these individuals.[30] African American

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and Latino men reported significantly lower levels of access to a provider to see if COVID-19 testing would be appropriate (p = 0.013), lower utilization of medical services (p = 0.001), and less use of telehealth for mental health services (p = 0.001).[43] The disproportionate social disruption and losses from COVID-19 also contributed to a wide range of health and quality-of-life outcomes amongst these populations.[44, 45]

Data regarding disparities in access to ED treatment are scarce. There is some evidence that there are disparities in sexual dysfunction outcomes following prostate cancer treatments in African-American men relative to ethnically different counterparts.[46] Disparities in urologic healthcare delivery and access; however, have been more thoroughly researched and documented in the published medical literature. These studies have demonstrated that there are apparent differences in urologic healthcare delivery and access among racial and ethnic groups in the US.[58] This has been shown in urologic cancer screening, treatment choices, and survival, as well as in the arena of chronic kidney disease, transplant allocation, and transplant outcomes.[58]

Healthcare barriers that inhibit support for men seeking care for ED were already in existence before COVID-19,[59] and the disparities in access to all healthcare were exacerbated by the pandemic.[56] This further reinforces the need to ensure that these ED treatment barriers are not additionally amplified. A greater focus must be paid to health equity, including providing increased resources and supplies for affected groups, adapting to inequities in the existing environment, and ensuring adequate access to healthcare services to ameliorate the burden of COVID-19 on African American and Latino male respondents.[43]

Aside from disparities in access to healthcare, other factors may also play a role in the differential impact of COVID-19 on particular subgroups of vulnerable populations. There is some evidence that Latino men may be affected more often by ED than Caucasian men in the US.[58] Evidence of racial differences in endothelial function has been known for over a decade; black race is independently associated with arterial endothelial function and this plays a role in overall cardiovascular risk.[63] A previous study found that the

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prevalence of ED among different racial and ethnic groups in the US is the result of complex phenomena and may be dependent upon the interplay of socioeconomic, demographic, medical, cultural, and lifestyle characteristics.[64]

Pathways Forward

The COVID-19 pandemic has brought to light a remarkable awareness on many health and social issues, including ED and men's health.[42] The four topics that emerged from the scoping review illustrate the far-reaching effects of COVID-19 on ED. Evidence that the COVID-19 pandemic may precipitate or worsen ED through biological and mental health effects is emerging and compelling. Preliminary evidence showed a significant association between ED and COVID-19, with a 5.27 odds ratio [95% CI: 1.49–20.09]. Multiple pathways and factors associated with ED and the significance of COVID-19 were identified in the published medical literature (**Figure 4**).

There is reason to suspect that impaired vascular function and ED might persist in COVID-19 survivors and even become a public health issue.[65] In patients recovered from COVID-19, ED evaluation and consultation may be important.[21] Getting effective public health messages out to the population is vital and this current pandemic has demonstrated the need for more focused views on men's sexual health.[2, 3]

Studies with larger cohorts of subjects who were infected with COVID-19 are needed to evaluate the degree of impact on men's health.[21] As data accumulate in administrative health databases, retrospective analyses may be conducted to better understand the patterns of interactions that men with ED had with the healthcare system through COVID-19 and to capture the extent of the impact of COVID-19 on pre-existing and emergent ED. Patient surveys such as the National Health and Nutrition Examination Survey (NHANES) and the National Ambulatory Medical Care Survey may be helpful in collecting patients' experiences with ED during and after COVID-19.

There are several limitations of this scoping review. Given the breadth of topics reviewed from the

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693 peer-reviewed articles, we did not conduct a formal systematic review or meta-analysis. Moreover, given the paucity of primary data showing the relationship between COVID-19 infection and ED, many unanswered questions remain. In addition, publication bias may have affected the reported relationships and we were unable to assess the magnitude of publication bias given the limited studies. Finally, the generalizability of the findings may be limited given the significant variability in the underlying causes of and the varying healthcare systems, practices, and health infrastructure across the globe.

Conclusions

In conclusion, this scoping review of the literature showed emerging evidence that COVID-19 has a uniquely harmful impact on men's health and erectile function through biological, mental health, and healthcare access mechanisms. ED could be a concerning consequence for a large segment of the male population given the high transmissibility of COVID-19; therefore, long-term and well-designed studies are needed to clarify the extent of the impact of COVID-19 on ED. Men presenting with ED after COVID-19 infection may have underlying endothelial dysfunction and vasculature issues and hence pulmonary and cardiovascular complications from COVID-19. A strategic focus on gender in the COVID-19 response will be critical for mitigating the impacts of the pandemic.[3, 47] The pandemic exposed vulnerabilities within worldwide healthcare and social systems, some of them including services concerning sexual health.[42] Telemedicine may be helpful in diagnosing and treating sexual medicine patients[55] and in ameliorating the burden of COVID-19 on vulnerable and marginalized populations.

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Table 1. Characteristics of the included studies and a summary of the findings

Study	Country of Origin	Study Design	Findings	Topic			
				Biological Impact	Mental Health Impact	Access to Care Impact	Health Disparities
Lisco et al. 2021[1]	Italy	Narrative Review	• Data support a role of T as a bivalent COVID-19risk factor for poor prognosis (high/normal in younger; lower in elderly) • Testicular damage may be a harmful consequence of infection even if the patient was asymptomatic	√			
Pijls et al. 2020[4]	Netherlands	Systematic Review & Meta-Analysis	• Screened 11.550 titles and included 59 studies comprising 36,470 patients in the analyses	√			

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			• Men had a higher risk for infection with COVID-19 than women (relative risk (RR) 1.08, 95% CI 1.03 to 1.12) • When infected, they also had a higher risk for severe COVID-19 disease (RR 1.18, 95% CI 1.10 to 1.27), a higher need for intensive care (RR 1.38, 95% CI 1.09 to 1.74) and a higher risk of death (RR 1.50, 95% CI 1.18 to 1.91)				
Duran et al. 2021[10]	Turkey	Multi-center retrospective chart review	• Andrological problems in 721 of 4,955 males • During COVID-19, there was a significant increase in andrological diagnosis compared to pre-COVID-19 (n = 293 [17%] vs n = 428 [13.2%], P < .001, respectively) • There was a significant increase in male reproductive or sexual health problems (n = 107 [6.2%] vs n = 149 [4.6%], P = .016 and n = 186 [10.8%] vs n = 279 [8.6%], P = .013, respectively) • ED diagnosis was also significantly higher than pre-COVID-19 (n = 150 [8.7%] vs n = 214 [6.6%], P = .008)	√			

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Sansone et al. 2021[11]	Italy	Patient Survey	• 100 subjects (25 COVID-positive; 75 COVID-negative) • The prevalence of ED was significantly higher in the COVID+ group (28% vs. 9.33%; p = 0.027) • Logistic regression models confirmed a significant effect of COVID-19 on the development of ED, independently of other variables affecting erectile function, such as psychological status, age, and BMI [OR 5.66, 95% CI: 1.50–24.01] • Likewise, subjects with ED were more likely to have COVID-19, once corrected for age and BMI [OR 5.27, 95% CI: 1.49–20.09]	√			
Jin et al. 2020[12]	China	Narrative Review	• Endothelial cells with high levels of angiotensin-converting enzyme 2 expression are major participants and regulators of inflammatory reactions and coagulation • Endothelial activation and dysfunction participate in COVID-19 pathogenesis by altering the integrity of vessel barrier, promoting pro-coagulative state, inducing	√			

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			endothelial inflammation, and even mediating leukocyte infiltration				
Konstantinopoulos et al. 2007[13]	Greece	Narrative Review	• Endothelial dysfunction is a pathological entity that multiply affects the health status • ED is recognized as a condition that is strongly interrelated with endothelial dysfunction, being a vascular event itself	√			
Fu et al. 2020[14]	China	Laboratory (Pre-Clinical) Research	• High level of ACE2 expression in testis, cardiovascular and gastrointestinal system indicated that SARS-CoV-2 might not only attack the lungs, but also affect other organs, particularly the testes, thus it may severely damage male sexual development for younger male and lead to infertility in an adult male, if he contracted COVID-19	√			
Zhang et al. 2020[15]	Canada	Narrative Review	• The finding that SARS-CoV-2 and SARS-CoV use the ACE2 receptor for cell entry has important implications for understanding SARS-CoV-2 transmissibility and pathogenesis • SARS-CoV and	√			

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			likely SARS-CoV-2 lead to downregulation of the ACE2 receptor, but not ACE, through binding of the spike protein with ACE2. leading to viral entry and replication, as well as severe lung injury				
Rajendran et al. 2013[16]	Japan	Narrative Review	• Alterations of endothelial cells and the vasculature play a central role in the pathogenesis, as endothelial cells have the key function in maintenance of patent and functional capillaries	√			
Shoar et al. 2020[17]	USA & Iran	Case Report	• Presents the clinical course of 2 males with COVID-19 who developed sexual dysfunction, as anorgasmia, after COVID-10 • Although no evidence of viral replication or inflammatory involvement could be identified in these cases' urogenital organs, a lack of other known risk factors for anorgasmia points to the role of COVID-19 as the contributing factor	√			
Fraietta et al. 2020[18]	Brazil	Narrative Review	• There is the theoretical possibility that testicular damage and subsequent infertility may	√			

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			result following COVID-19 infection • Available data and study findings are recent, based on small sample sizes, and present conflicting information				
Navarra et al. 2020[19]	Italy	Narrative Review	• Testicular cells expressing both ACE2 and TMPRRS2 are rare, suggesting that the virus may not harm male gametes • However, SARS-CoV-2 could indirectly compromise male gametes, testicular cells, and therefore fertility because the fever and the cytokine storm associated with COVID-19 induce a sperm DNA fragmentation and reduce the male reproductive	√			
Vishvkarma | & Rajender 2020[20]	India	Systematic Literature Review	• The presence of ACE2 on almost all testicular cells and the report of a significant impact of previous SARS coronavirus on testes suggest that SARS-CoV-2 is highly likely to affect testicular tissue, semen parameters and male fertility	√			
Corona et al. 2020[21]	Italy	Literature Review	• Several molecular characteristics of the SARS-CoV-2 can justify the presence of virus	√			

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			within the testis and possible alterations of spermatogenesis and endocrine function. • Orchitis has been reported as a possible complication of SARS-CoV infection, but similar findings have not been reported for SARS-CoV-2. Alternatively, the orchitis could be the result of a vasculitis as COVID-19 has been associated with abnormalities in coagulation and the segmental vascularization of the testis could account for an orchitis-like syndrome. • Andrological consultation and evaluation of gonadal function including semen analysis should be suggested.				
Jannini 2017[22]	Italy	Narrative Review	• Sexual medicine can be used as a new tool to understand and manage non-communicable diseases and as a marker of systemic health • Moreover, the multipronged application of systems medicine to pathophysiologic	√	√		

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			changes leading to sexual dysfunction might sustain the growth of a young science such as sexual medicine				
Abbas et al. 2020[23]	Egypt	Expert Commentary	• COVID-19 harms the reproductive and sexual health of males through psychological, immunological, or systemic effects • As a result of social isolation, some people become suffering from depressed mood, which disrupts chemicals in the brain that has a role in promoting libido in females and males. • Acute cardiac injury leads to a decrease in blood supply to the genitalia, and this can end with impotence • ICU use of thiazide-type diuretics, the aldosterone receptor blockers, the β-adrenergic receptor blockers, or ACE inhibitors to control blood pressure can cause ED • Strokes have negative impacts on sexual function and desire, causing a significant decline in erection or ejaculation	√	√		
Mao et al. 2020[24]	China	Case Series	• Among 214 patients with COVID-19, 36.4% had	√	√		

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			neurologic symptoms and were more common with severe infection (45.5%) • Patients with more severe infection had greater neurologic manifestations such as acute cerebrovascular diseases (5 [5.7%] vs 1 [0.8%]), impaired consciousness (13 [14.8%] vs 3 [2.4%]), and skeletal muscle injury (17 [19.3%] vs 6 [4.8%]).				
Beghi et al. 2020[25]	Italy	Narrative Review	• COVID-19 is an influenza virus with neurotropic potential, presents with neurological manifestations many individuals • Postinfectious neurological complications are the result of the activation of immune mechanisms and can explain the insurgence of immune-mediated diseases	√	√		
Thomas & Konstantinidis 2021[26]	Greece	Narrative Review	• The pathophysiology of ED remains a labyrinth. • Underlying mechanisms of ED may be vasculogenic, neurogenic, anatomical, hormonal, drug-induced and/or psychogenic	√	√		

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			• Neurogenic ED consists of a large cohort of ED, accounting for about 10% to 19% of all cases				
Wu et al. 2020[27]	China	Narrative Review	• Viral infections have detrimental impacts on neurological functions, and even to cause severe neurological damage • Coronaviruses (CoV), especially SARS-CoV-2, exhibit neurotropic properties and may cause neurological diseases	√	√		
Roychoudhury et al. 2021[28]	India	Narrative Review	• Preliminary findings so far suggest the possibility of both direct and indirect infection ofSARS-CoV-2 in the reproductive system of males and possible impact on general health and well-being potentially leading to infertility • Evidence indicates a possible long-term effect of the pathogenicity of SARS-CoV-2 infection on testicular tissue, which may further impact reproductive performance	√	√		
Lipsky & Hung 2020[3]	USA	Narrative Review	• Plausible theories for why men respond differently	√			√

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			to the SARS-CoV-2 infection include sex-related differences in angiotensin-converting enzyme 2 receptors, immune function, hormones, habits, and coinfection rates • Data from the CDC demonstrate disparities among racial and ethnic minorities, with mortality rates for African American and Latino men exceeding those for White or Asian males • Continuing to collect data disaggregated by sex can help us understand why men are more likely to experience severe disease				
Pennanen-Iire et al. 2021[29]	Finland	Narrative Review	• COVID-19 affects sexual function with implications on overall health • Increased awareness of health-care providers on sexual health implications related to the COVID-19 is needed • Telemedicine has an imperative role in allowing continued support at times of lockdown and preventing worsening of the	√	√	√	

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			sexual, mental, and physical health after the pandemic.				
Riley et al. 2020[30]	USA	Expert Commentary	• The strain that the outbreak imposes on health systems will undoubtedly impact the sexual and reproductive health of individuals living in low- and middle-income countries (LMICs); however, sexual and reproductive health will also be affected by societal responses to the pandemic, such as local or national lockdowns that force health services to shut down if they are not deemed essential, as well as the consequences of physical distancing, travel restrictions and economic slowdowns	√	√		√
White 2020[2]	UK	Narrative Review	• Men's vulnerability to COVID-19 demonstrates the biological and socio-cultural factors at play and we are all affected • The emotional impact of the lockdown and the longer term emerging recession coupled with the complex grieving many will be experiencing	√	√	√	√

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			will result in high mental health burden and increased rates of suicide in men • There will be consequences of people being unable, or unwilling, to seek medical help • Loss of school will mean for many of the most vulnerable the loss of critical services and a safe and nurturing environment increasing the risk of depression, self-harm, attempted suicide				
Sansone et al. 2020[5]	Italy	Narrative Review	• Endothelial dysfunction, subclinical hypogonadism, psychological distress and impaired pulmonary hemodynamics all contribute to the potential onset of ED • COVID-19 might exacerbate cardiovascular conditions; therefore, further increasing the risk of ED • Testicular function in COVID-19 requires careful investigation for the unclear association with testosterone deficiency and the possible consequences for	√	√	√	√

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			reproductive health • Confinement and the illness in itself are both causes of stress; while only a minority of individuals might be more vulnerable to psychological trauma, there is no doubt that most people would experience some degree of emotional distress following isolation, social distancing, loss of relatives and friends, difficulties in securing medications, as well as the obvious economic consequences of lockdown				
Sathyanarayana & Andrade 2020[31]	India	Narrative Review	• Lockdown, forced proximity, anxiety about work and finances, and other stresses could trigger or worsen psychiatric disorders • Stress is itself is related with disturbances in sexual functioning, and so lockdown-related stressors can result in such disturbances even in persons who are psychiatrically stable		√		
Paul et al. 2020[32]	Brazil	Expert Commentary	• Social distancing and quarantines have been necessary as public health strategies,		√		

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			they may contribute to psychological and mental problems • Anxiety and depression may translate into higher rates of psychogenic sexual dysfunction				
Banerjee & Rao 2020[33]	India	Narrative Review	• Long-term psychosocial and occupational outcomes of health-care workers dealing with SARS patients showed a rise in ED, premature ejaculation (PME), lack of sexual satisfaction in partners, and heightened performance anxiety. This contributed to the burnout, work stress, absenteeism, substance abuse, and depressive disorders. • Literature related to sexual health and current COVID-19 pandemic is still in their infancy		√		
Li et al. 2020[34]	China	Patient Survey	• 44% of participants reported a decrease in the number of sexual partners and about 37% of participants reported a decrease in sexual frequency • Multiple regression analysis showed that age, partner		√		

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			relationship, and sexual desire were closely related to sexual frequency				
McKay et al. 2020[35]	USA	Patient Survey	• Among 728 gay and bisexual men, many made significant changes to their sexual behavior and partner selection. • Men engaged in new strategies to reduce their risks of infection from partners, and expressed high levels of concern about how HIV may affect COVID-19 risk, treatment, and recovery		√		
Maretti et al. 2020[36]	Italy	Narrative Review	• COVID-19 has dramatically affected the quality of life by changing inter-personal relationships, community life and obviously sexual health.		√		
Karsiyakali et al. 2020[37]	Turkey	Patient Survey	• Based on the International Index of Erectile Function and Female Sexual Function Index (FSFI) forms, a decline in sexual functioning was observed during the COVID-19 pandemic period • Living in a metropolitan area was associated with a decline in both sexual intercourse frequency and sexual desire		√		

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			during the COVID-19 pandemic				
Fang et al. 2020[38]	China	Patient Survey	• 8.4% and 8.5% subjects had deteriorated erectile function or ejaculation control ability by self-evaluation, whereas 31.9% and 17.9% subjects had decreased IIEF-5 scores or increased PEDT • Subjects with deteriorated erectile function and decreased IIEF-5 scores had higher General Anxiety Disorder-7 (P < .001 and P < .001) and higher Patient Health Questionnaire-9 score (P < .001 and P = .002) after the epidemic, decreased frequency of sexual life (P < .001 and P < .001) and physical exercise (P = .009 and .007) after the epidemic		√		
De Rose et al. 2020[39]	Italy	Patient Survey	• A higher proportion of health care workers had low sexual desire (65.3% vs 56.8%, p = 0.042) • Age, being female, being a health care worker, having children at home, living with the partner, and having low sexual satisfaction were predictors of low level of sexual		√		

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			desire				
Bulut et al. 2021[40]	Turkey	Patient Survey	• Both stress disorder and ED were seen at higher rates in healthcare professionals ($p < .001$). • The median IIEF-5 scores of nurses, married subjects, and those working in the Diagnosed Patient Area, were found to be higher ($p < .001$, $p = .014$, $p = .011$ respectively)		√		
Karagöz et al. 2020[41]	Turkey	Patient Survey	• Sexual function scores (IIEF erectile function domain and total FSFI) were lower during pandemic (24.55 ± 5.79 and 24.87 ± 7.88, respectively) vs. pre-pandemic period (26.59 ± 4.51 and 26.02 ± 6.22) ($p = 0.001$ and $p = 0.027$, respectively) • The frequency of sexual intercourse decreased in men ($p = 0.001$) while sexual avoidance and solitary sexual approach behaviors (masturbation or watching sexual content videos, etc.) increased ($p = 0.001$)		√		
Carvalho et al. 2020[42]	Portugal	Expert Commentary	• The time of COVID-19 has required healthcare and social systems, clinicians, and		√	√	

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			citizens to adjust to the digital era in a matter of days. There is little evidence on how professionals and patients appraise such tools and whether these are effective • Psychological distress in this specific scenario must be accounted by sexual health professionals, given the strong comorbidity between emotional disorders and sexual dysfunction				
Ruprecht et al. 2020[43]	USA	Patient Survey	• Marginalized populations experienced significant disparities in COVID-19 exposure, susceptibility, and treatment access, as well as in psychosocial effects of the pandemic • Notably, Black and Latinx populations reported significant difficulties accessing food and supplies (p = 0.002) • Healthcare access disparities were also visible, with Black and Latinx respondents reporting significantly lower levels of access to a provider to see if		√	√	√

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			COVID-19 testing would be appropriate (p = 0.013), medical services (p = 0.001), and use of telehealth for mental health services (p = 0.001)				
Purtle 2020[44]	USA	Expert Commentary	• There are specific aspects of the COVID-19 pandemic that could cause it to have disproportionately adverse impacts on the mental health of racial/ethnic minorities as well as low-income populations • Socially disadvantaged groups (e.g., racial/ethnic minorities, people with low income) will experience more psychiatric morbidity related to the pandemic than advantaged groups. • The origins of these disparities are structural in nature • Historically produced arrangements of power and privilege provide socially advantaged groups with more resources to limit their exposure to, and cope with, stressors caused by disaster		√	√	√

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Ibrahimi et al. 2020[45]	USA	Expert Commentary	• COVID-19 has unveiled the distressful reality of racial disparity in the US, with African Americans bearing a disproportionate burden of morbidity and mortality due to COVID-19 • Systemic racism is the primary operator of mental health disparity, which disproportionately affects African American families at all levels of the social ecological model • Programs tailored towards reducing the disproportionate detrimental effects of COVID-19 on the mental health of African Americans need to be culturally appropriate and consider the nuances of systemic racism, discrimination, and other institutionalized biases		√	√	√
Burnett et al. 2016[46]	USA	Literature Review	• Some reports suggest a relatively greater trend in African-American men than other ethnic groups toward obtaining clinical management for sexual dysfunction and experiencing		√	√	√

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			psychosocial effects from it, lending additional support for the possibly greater effect of this problem in African-American men				
Betron et al. 2020[47]	USA	Expert Commentary	• The global health community has tools to engage men and promote healthy masculinities, drawing on two decades of programs and research. • To improve, we must gather evidence on both biological and social differences in men, including age and race, and tailor health strategies, accordingly. • A strategic focus on gender in the COVID-19 response will be critical for mitigating the impacts of the pandemic, as well as for ensuring uptake of future treatments and vaccines.		√	√	√
Tonyali et al. 2020[48]	Turkey	Narrative Review	• All elective surgeries for benign urological conditions such as urinary tract stone disease that not caused complicated obstruction, benign prostate enlargement,			√	

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			infertility, incontinence and genitourinary prolapse, ED, undescended testis, vesico-ureteral reflux should be postponed till the lasting of Covid-19 outbreak				
Cocci 2020[49]	Italy	Expert Commentary	• Patients with Peyronie's disease, requesting a penile implant, and anyone who needs treatment for erectile dysfunction will not be able to access treatment. • We are not in a position to currently criticize these historical moments, but certainly, as health managers, we also have a duty to think about these patients.			√	
Aboumohamed et al. 2021[50]	USA	Urologist Survey	• 478 total urologic surgeries were canceled and categorized: 250 Level 1, 130 Level 2, 98 Level 3 (73 adult, 25 pediatric). Level 3c involved renal cell carcinoma ≥ T2b, high-grade bladder urothelial carcinoma, adrenal mass/cancer > 6 cm, testicular cancer requiring radical orchiectomy, and penile cancer • Surgeries for urologic			√	

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			reconstruction, non-complicated nephrolithiasis, erectile dysfunction, and urinary incontinence were considered Level 1				
Witherspoon et al. 2020[51]	Canada	Urologist Survey	• Physical examination has a limited role in the evaluation and management of ED and, therefore, this condition lends itself well to virtual visits • Including the partner (if applicable) in the virtual visit can help elucidate their overall treatment goals more easily			√	
Vaduganathan et al. 2020[52]	USA	Retrospective Database Analysis	• The modest decline for most common long-term therapies after peak could represent reduced contact with prescribing clinicians, restricted access to pharmacies, pharmacist rationing, loss of insurance from unemployment, or replete supplies from early stockpiling. • Steep declines for amoxicillin and azithromycin appeared out of proportion to expected seasonal declines and could represent fewer outpatient			√	

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			prescriptions for upper respiratory tract infection symptoms.				
Jeffery et al. 2020[53]	USA	Retrospective Database Analysis	• The decrease in ED visits ranged from 41.5% in Colorado to 63.5% in New York. • The weeks with the most rapid rates of decrease in visits were in March 2020, which corresponded with national public health messaging about COVID-19. • Hospital admission rates from the ED were stable until new COVID-19 case rates began to increase locally; the largest relative increase in admission rates was 149.0% in New York, followed by 51.7% in Massachusetts, 36.2% in Connecticut, 29.4% in Colorado, and 22.0% in North Carolina.			√	
Hartnett et al. 2020[54]	USA	Retrospective Database Analysis	• During the early pandemic period, the total number of U.S. ED visits was 42% lower than during the same period a year earlier, with the largest declines in visits in persons aged ≤14 years, females, and the Northeast region.			√	
Dooley et al. 2020[55]	USA	Literature Review	• Virtual visit utilizing audiovisual			√	

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			telecommunications is a very attractive approach for sexual medicine patients. • Many patients with sexual medicine problems are no longer going to accept the antiquated method of healthcare involving making an appointment, visiting a brick-and-mortar facility, and the requirement of having a physical examination. • The new normal will be communicating with patients by utilizing telemedicine.				
Czeisler et al. 2020[56]	USA	Patient Survey	• By June 30, 2020, because of concerns about COVID-19, an estimated 41% of U.S. adults had delayed or avoided medical care including urgent or emergency care (12%) and routine care (32%) • Avoidance of urgent or emergency care was more prevalent among unpaid caregivers for adults, persons with underlying medical conditions, Black adults, Hispanic adults, young			√	√

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			adults, and persons with disabilities				
Papautsky et al. 2020[57]	USA	Patient Survey	• The top reported barrier to receiving health care was the fear of SARS-CoV-2 infection (126/374, 33.6%) • Almost half (1227/2570, 47.7%) of the participants reported experiencing health care delays			√	√
Klein et al. 2010[58]	USA	Narrative Review	• Disparity in urology care are apparent in urologic cancer screening, treatment choices, and survival, as well as in the arena of chronic kidney disease, transplant allocation, and transplant outcomes. • Latino men also seem to be affected more often by erectile dysfunction than Caucasian counterparts. • Disparities such as these have been identified as a problem in the delivery of health care in the US, and resources have been allocated to help allay the disparity.			√	√
Burnett et al. 2020[59]	USA	Narrative Review	• While federal and state mandates ensure access to treatment for women's breast			√	√

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			health, female-factor infertility, and gender affirmation to ensure that these individuals do not experience a diminished QoL, there are no comparable mandates for men's sexual and reproductive health. • The burden of ED necessitates a call to action to improve the accessibility of ED treatments.				
Shindel et al. 2020[60]	USA	Expert Commentary	• In many ways, sexual medicine is ideal for telemedicine. Sexual medicine care providers are a highly specialized group of clinicians who are frequently based in metropolitan areas. Patients travel great distances to see us; telemedicine may increase our reach to patients who cannot otherwise access specialized care.			√	√
Mmeje et al. 2020[61]	USA	Expert Commentary	• The COVID-19 pandemic offers the United States the opportunity to reexamine SRH delivery to hard-to-reach and vulnerable populations such as youth. • Providers can increase accessible			√	√

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			SRH services by removing traditional barriers to care that youth routinely encounter. • Virtual visits can also triage patients for in-person visits.				
Treadwell 2020[62]	USA	Expert Commentary	• The coronavirus pandemic has amplified health disparities by race and gender, perhaps most notably among African American men • Populations that have disproportionate rates of health conditions such as hypertension, diabetes mellitus, obesity, and cardiovascular disease are more susceptible to both contracting coronavirus and to adverse outcomes				√
Mulukutla et al. 2010[63]	USA	Prospective Cohort Study	• Black race is independently associated with arterial endothelial dysfunction. • Racial differences in CVD risk may be related, in part, to race-related differences in endothelial dysfunction.				√
Smith et al. 2009[64]	USA	Patient Survey	• Relative to white men, Hispanic (OR 1.05, 95% CI 0.99, 1.12), Asian (OR 1.1, 95% CI 1.02, 1.19), and other men (OR 1.13, 95% CI 1.06, 1.1.21)				√

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			had increased odds of moderate-severe ED, while black men were less likely to report moderate to severe ED (OR 0.86, 95% CI 0.81, 0.92). • Black (OR 0.54, 95% CI 0.48, 0.61) and Asian men (OR 0.91, 95% CI 0.80, 1.04) were less likely to have severe ED after adjustment for age, socioeconomic status, medical co-morbidities, and lifestyle characteristics.				

Figure 1.

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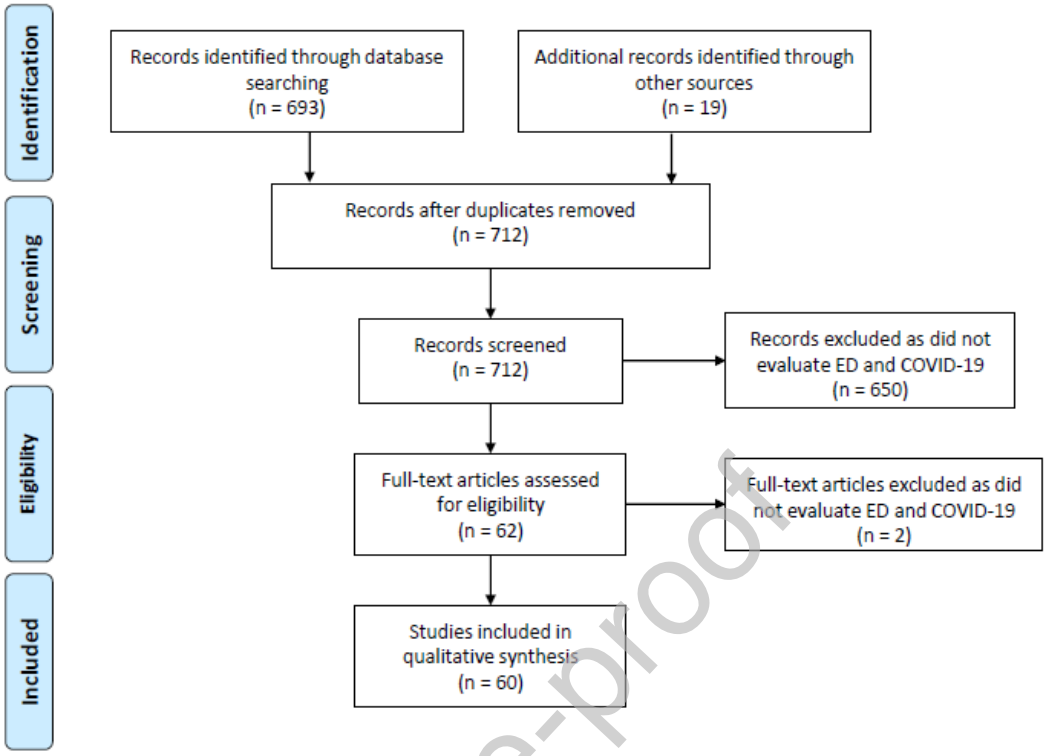

Figure 2.

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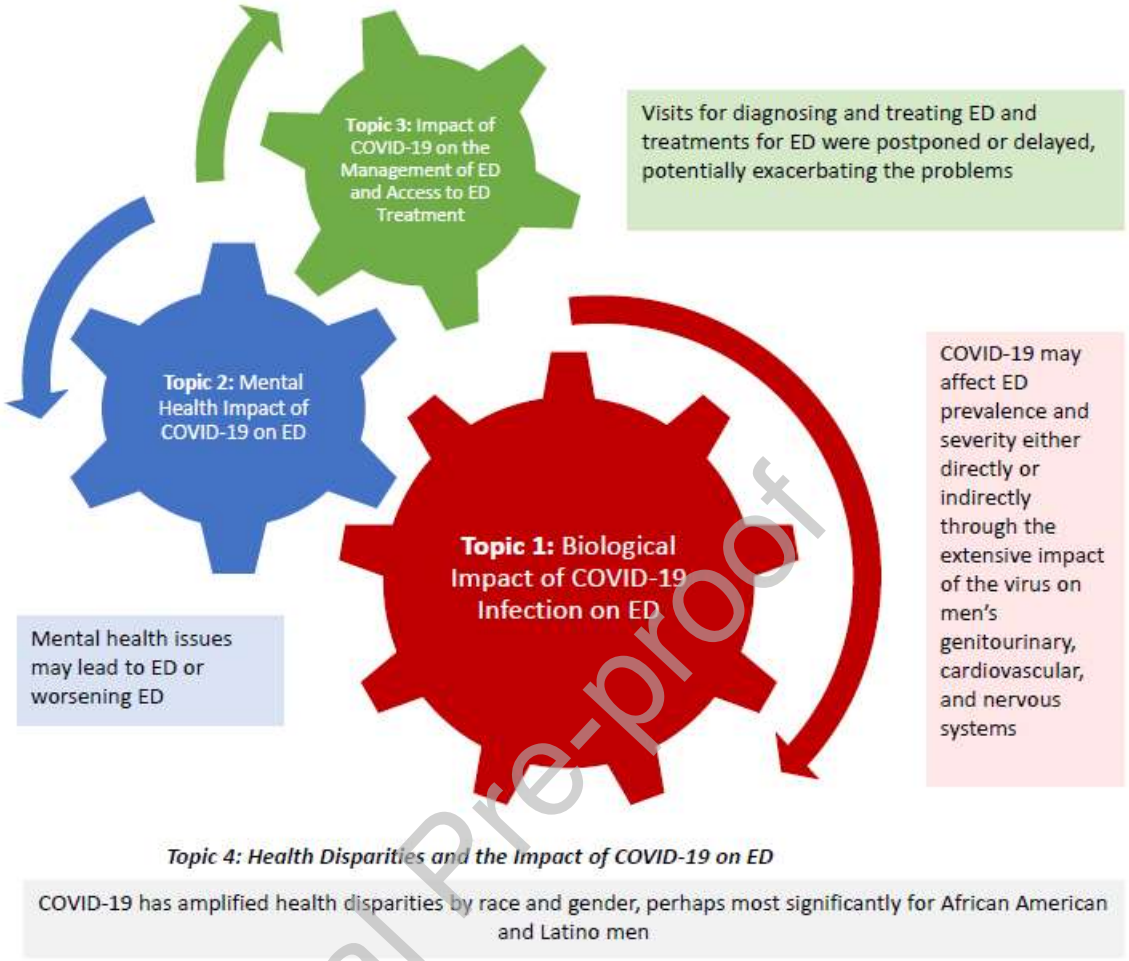

Figure 3.

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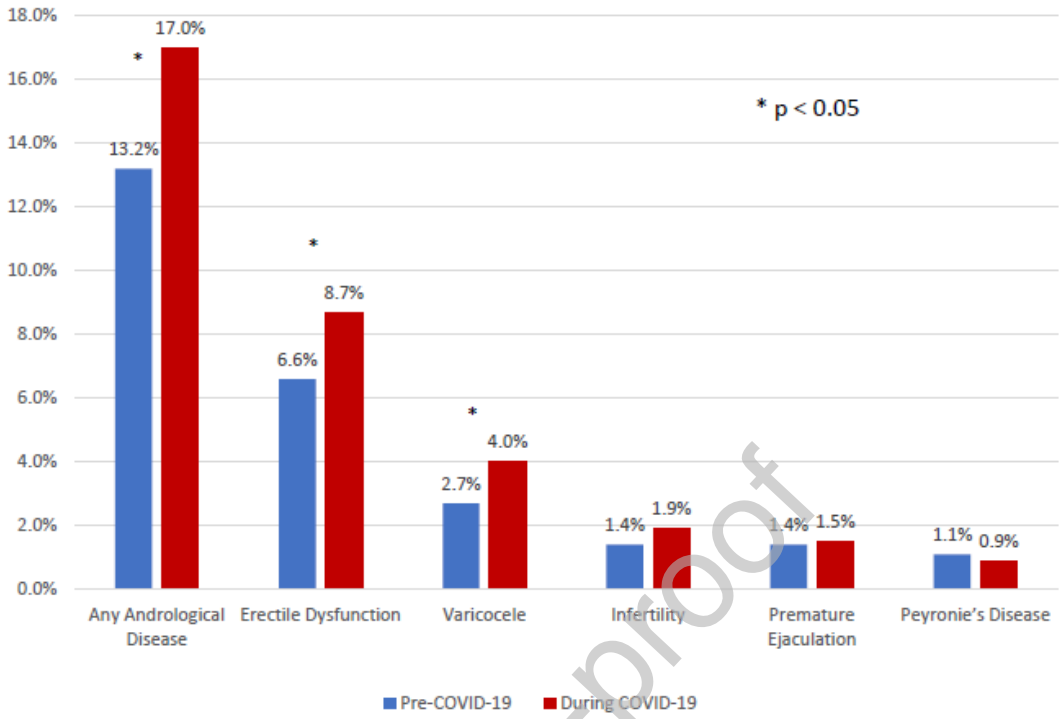

Figure 4.

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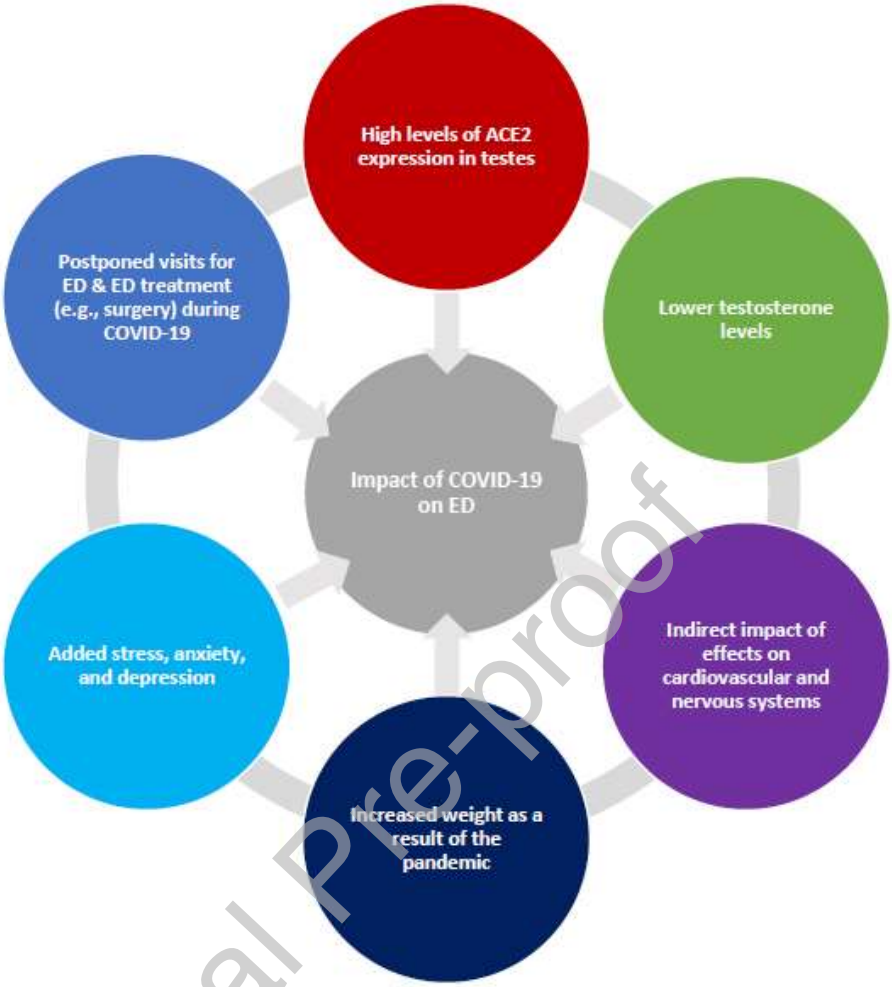

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